DIAMANT

DIGITAL FILM RESTORATION SOFTWARE
STEP-BY-STEP TUTORIAL FOR BEGINNERS

DIAMANT V2

Digital Film Restoration Software

STEP-BY-STEP TUTORIAL

As of: 6.11.2006

Sample images thanks to gratefull permission from:
Filmarchiv Austria (diverse samples, 1915-1930)

Table of Contents

1. Introduction

The aim of this document is to give a brief introduction on the DIAMANT film restoration software. By means of a demonstration sequence, the user will be guided through the basic work steps of installation, importing, restoring and exporting the sequence.

After installation the typical restoration process in DIAMANT may take place the restoration process may be divided into the following steps:
- Import
- Batch Processing
- Automatic and Semiautomatic Restoration
- Manual Restoration (M.I.R. Moving Image Retoucher)
- Export

The time required for automatic, semiautomatic and manual restoration steps will vary depending on the source material condition and the desired restoration quality.
All steps will be illustrated using the demo sequence provided with this tutorial.

2. Installation
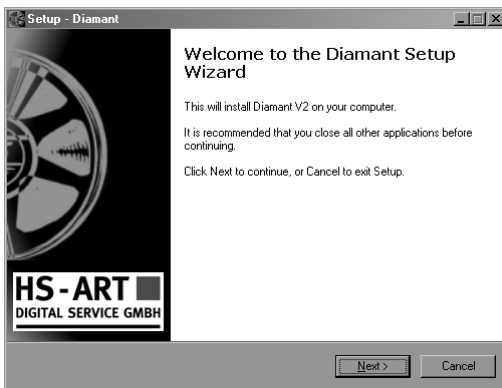
In this tutorial, we assume a single workstation setup without any additional facilities.

Insert the DIAMANT_V2 CD in your drive; log-into your workstation as a user with administrator-rights and start Setup.exe.

Setup leads you through the installation process that is pretty much self-explaining.
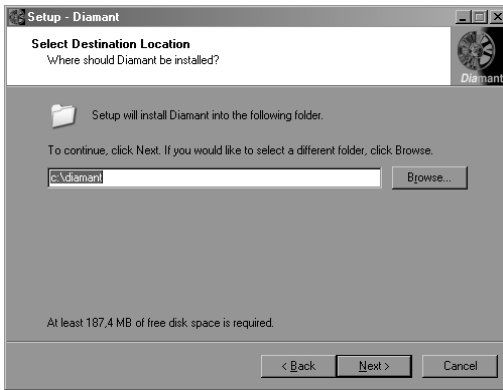
We strongly recommend keeping the proposed installation directory as c:\Diamant.
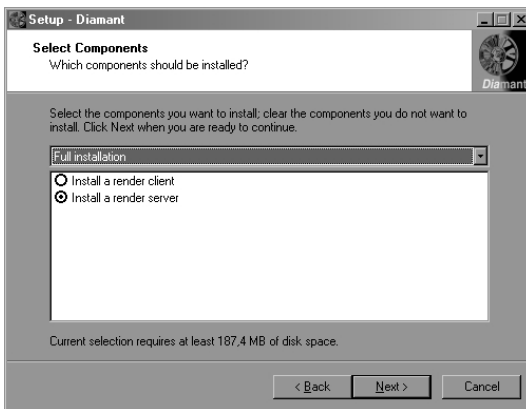
Choose: Install render server for installation of the central workstation.

After installation, an initial configuration needs to be done on the central workstation. The configurator is started directly by the installer and you need to complete the entries before confirming with Configure.
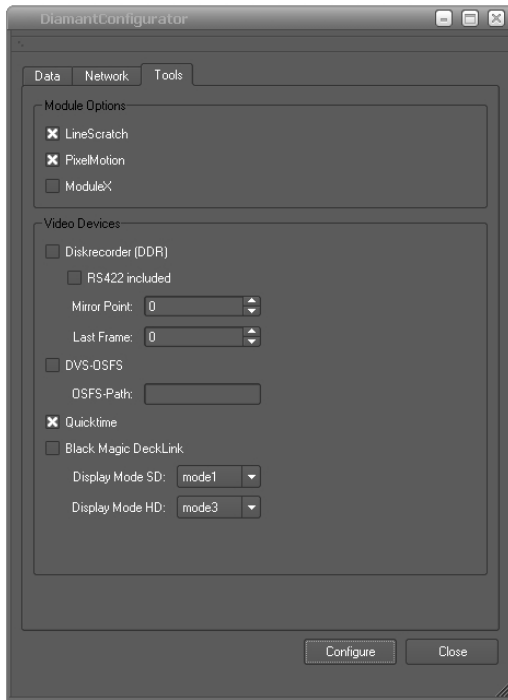
In the simplest case you can simply take the default settings, just make sure that the boxes for the Linescratch and PixelMotion are ticked!

For more details in respect to installation and following configuration we refer to our DIAMANT V2 Manual (chapter 2).

After successful installation and configuration you need to attach theUSB-license key (dongle) to an USB-port of your workstation!

3. How to Start DIAMANT

After successful installation of the DIAMANT software, the following icons are on your desktop:

These icons are used to start and stop all components of DIAMANT. To start the software double-click the "DIAMANT Start" Icon. This will launch the necessary DIAMANT components: DDS_Server, JobManager, JobLauncher and MovieManager. The Movie Manager will be your starting point now.

MovieManager
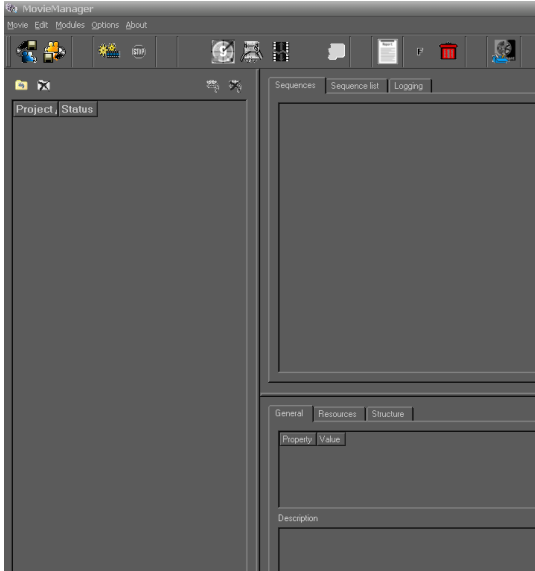
After starting the software, you will see the empty MovieManager window.

The MovieManager works as the explorer of your Diamant. The left side shows your projects.
You need to import images in order to create a new project.

4. Import

The tutorial sequence is provided as a set of sequentially numbered image files, saved in the folder: c:\Diamant\TutorialSequence\.
Later on - during "normal restoration" - you need to have your images ready on a connected Windows-drive.

Importing

To import the sequence into DIAMANT, click the "create new image sequence" button in the upper left corner of the MovieManager or select Movie/New from the menu.
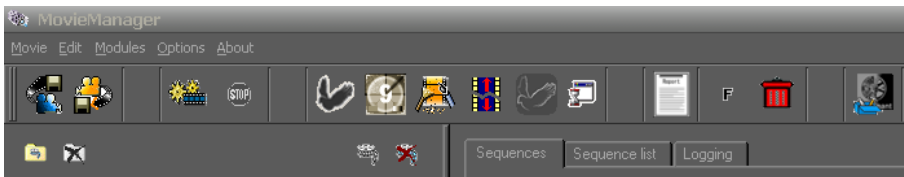
The CaptureManager, DIAMANT´s import-export tool will open:

First, check if "File Import" is selected in the Device box.

After that you need to enter names for the Project and the Movie. Our project will be called "tutorial", the movie name will be "testsequence". Enter these values into the fields at the top of the window.
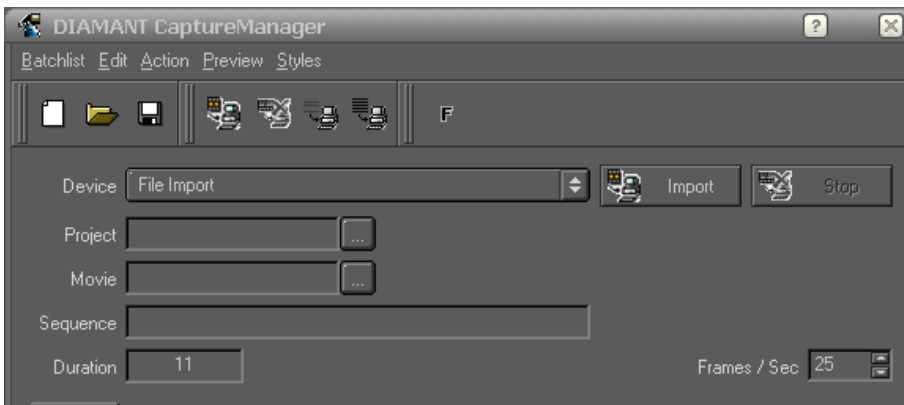
You can also enter a name for the sequence, if you do not, the directory name of images to be imported will be assigned (in our sample this is: "TutorialSequence").

Now, go directly to the source directory and tell the system where the source image files are

located. To do this, click on the browser button [...] in the middle of the window and select the folder containing the files provided with this tutorial.

As the frames are located in: c:\diamant\TutorialSequence\ the "Source" area of the window will look like this:
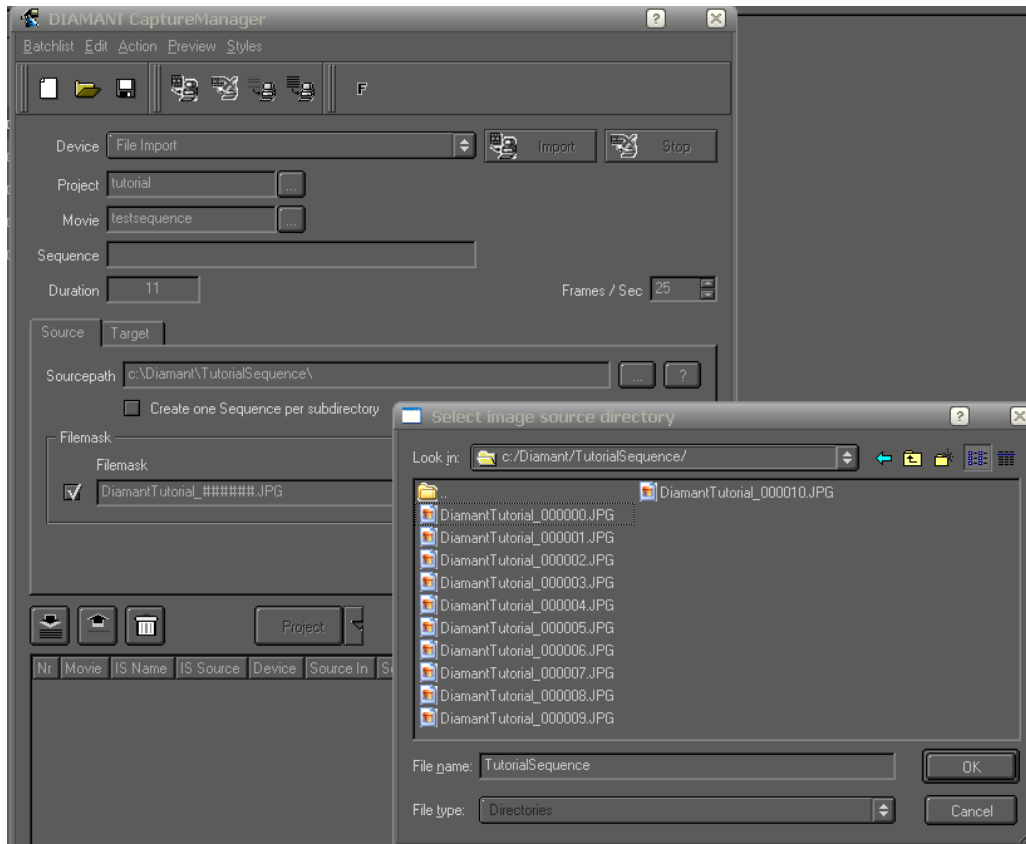
The "File mask" field reflects the naming scheme of the image files. Each "#" character represents one digit of the sequential number. In our case, the file names consist of the text "DiamantTutorial_", followed by a 6 digit number and the extension ".jpg". This is represented as "DiamantTutorial_######.jpg" in the file mask field.

After clicking OK in most cases, the file mask will be detected automatically when the source directory is selected. If not, it can also be entered manually in the file mask field.

The "Source In" and "Source Out" fields are automatically completed with the first and last frame number, however the values can be overruled by manual editing.

By now, the DIAMANT system has all information needed to import the sequence. You can thus start the import process by clicking the "Import" button at the top of the window.

After a very few seconds, the import process is finished. And the "Stop" button is greyed out

again. You can now close resp. exit the CaptureManager.

Now, you will see the new project in the repository panel on the left side of the MovieManager window. If the project is not visible you need to do a manual refresh by pressing function key F5 on your keyboard.

By clicking the "+" next to the folder icon, the project is opened, displaying the contained movie. By clicking on the movie, you will find the "TutorialSequence" sequence in the "Sequences" tab.
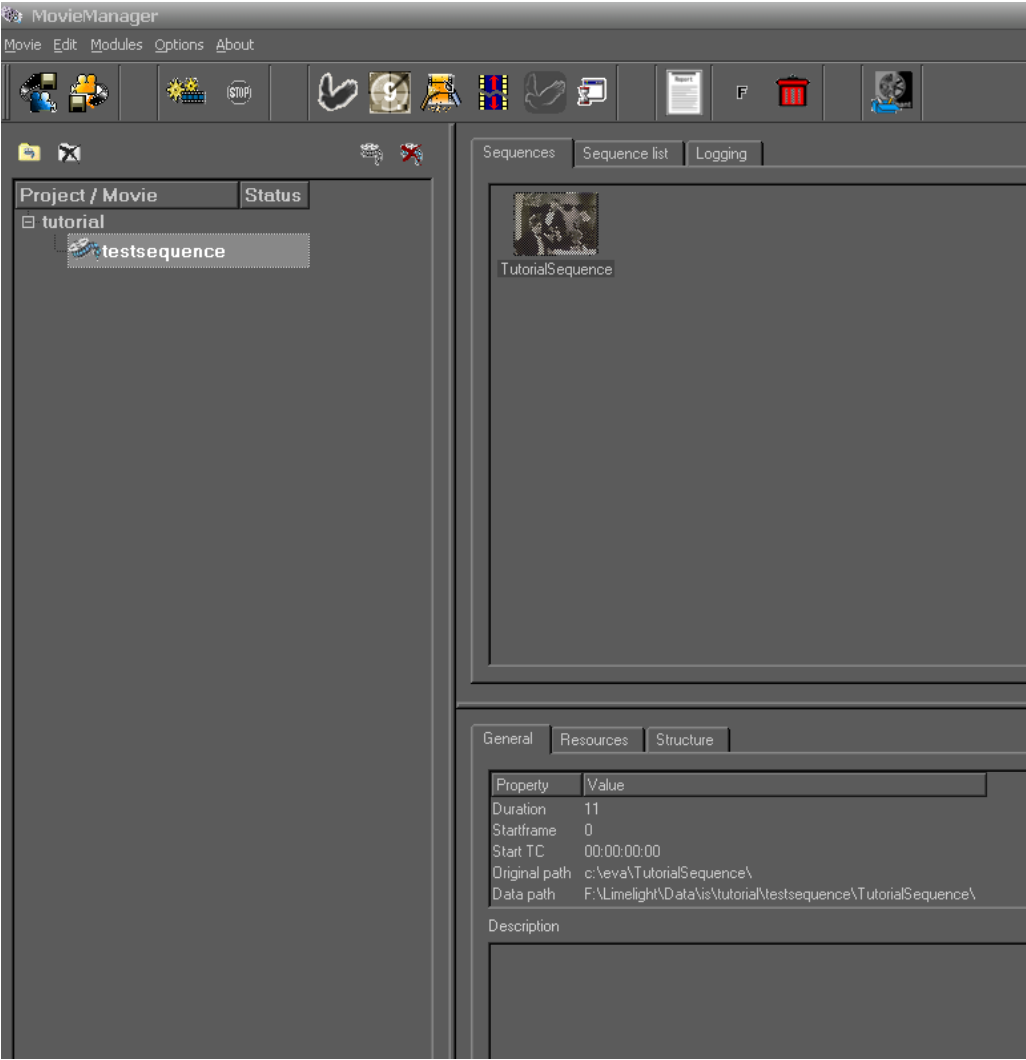
5. First Analysis of the Film

To get a first impression of the damages and therefore a first impression which kind of modules for restoration will be needed, it makes sense to play the sequence. Therefore you are

use the MoviePlayer symbol.

Select the sequence and then click on the player to open the sequence. You should decide, if you have to restore flicker problems, dust problems, stabilization problems, etc. Depending on these decisions you start the restoration process.

6. Batch Processing
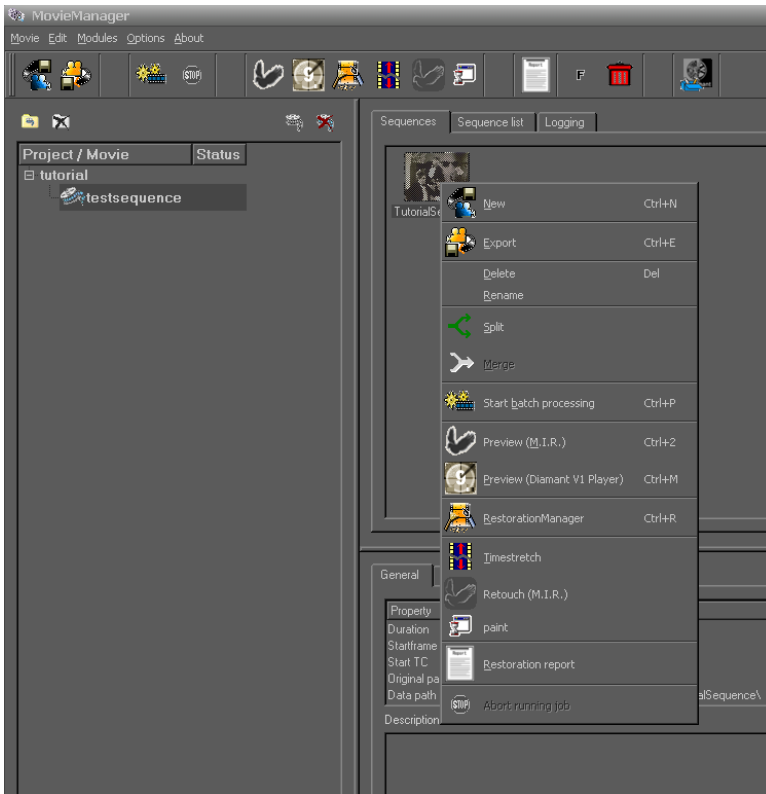
Batch processing prepares the sequence for later restoration operations. The batch processing is divided into modules which can be individually selected.

To start the batch processing, right-click the sequence in the "sequences" tab and select "Start batch processing" from the context menu.

This will open the batch processing window. In this window, the individual batch processing modules can be turned on (green) and off (grey) by selecting the buttons.

Whereas "Preprocess" has to be selected in any case, the others depend on your restoration requirements

For the tutorial sequence, make sure that all steps except "LocalMotion" are turned on (green). LocalMotion and PixelMotion are calculating and saving equal background information, so therefore only one of these modules is required. PixelMotion is the quicker one.
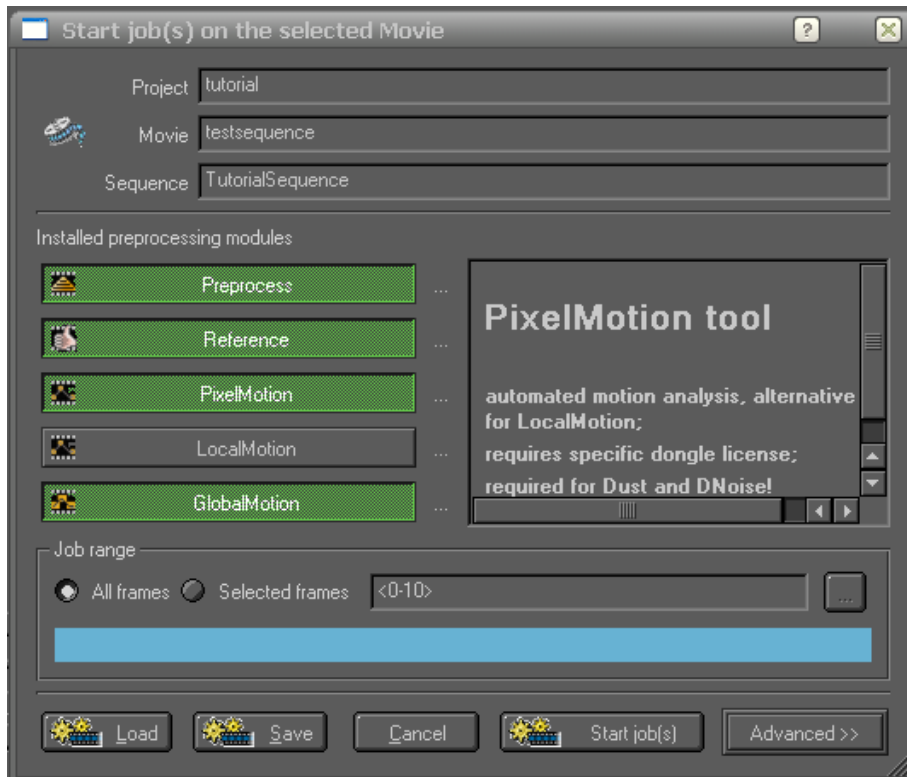
To continue, click the "Start Job(s)" button at the bottom of the window.

Depending on your computer's processing speed, the Batch Processing job can take a few minutes to complete. During this time, the MovieManager will display "scheduled" or "running" under the sequence's icon, together with the current progress.
After that, the sequence is prepared and ready for restoration.

For the use of advanced batch processing look up in the DIAMANT V2 Manual.

7. Automatic and Semiautomatic Restoration

As soon as the batch processing is finished, the sequence can be opened to start the actual restoration work. To do this, double-click on the sequence icon in the MovieManager (or click right and select RestorationManager).

This opens a new application, the RestorationManager.
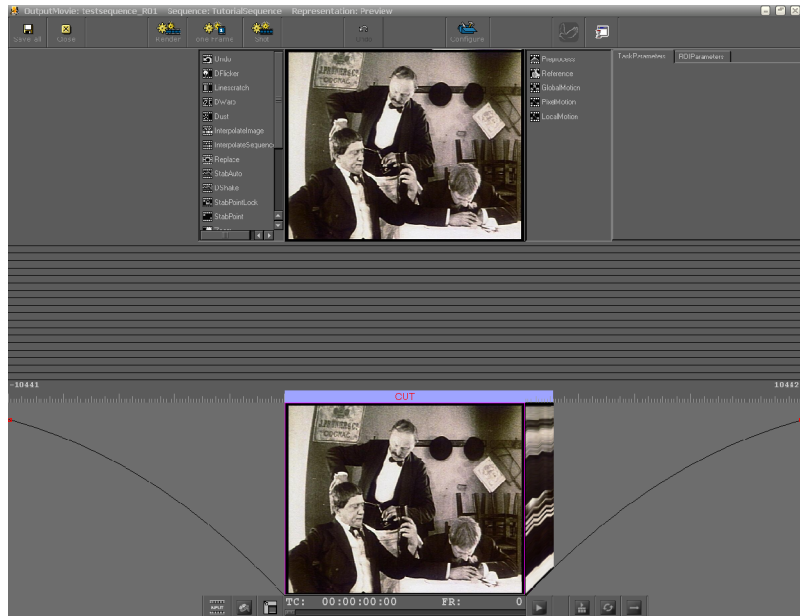
The RestorationManager displays the original in the bottom-window. Above there is the time-line where the desired restoration modules can be placed. On top, the output displays the results of the restoration process.

Use the cursor keys (<- and ->) to move through the sequence, frame by frame and the <space> bar to start and stop playback.

Try all possibilities to navigate to image number "7".

Left and right of the result image, two lists of tools can be found. The list on the left shows all available restoration tools, called "modules", while the list on the right shows the batch processing tools. In case you did not use the full selection for batch processing, you can do that anytime within the RestorationManager.

For viewing the sequence in full size press CTRL+TAB, you can go back any time by pressing CTRL+TAB again!

Immediately after activating the RestorationManager a new "Movie" will be created inside the MovieManager so that the new images can be written to a new "Generation".
This generation has the same name as the original movie, augmented by the suffix "_Rnn", where "nn" is the number of the generation. The first render generation of our movie is called
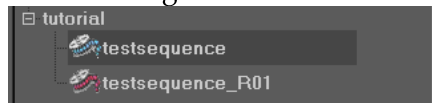
"testsequence_R01",   the next will be called "testsequence _R02" and so on. The output generation of our first render step will be used as the input for the next render step.

Restoration Manager and Automatic Restoration

DFlicker
In the first step, you will use the DFlicker module. To do this, select the "DFlicker" tool from the tool list on the left side and drag-and-drop it into a line of the work-area (=time-line).
The work area will now show a bar, representing the DFlicker module.
To get optimal results, Dflicker requires so called "Reference" images, indicating the level of desired characteristics. Check the automatically proposed "References" manually. Diamant proposes images "2" and "9" for reference. To jump from one reference frame to the next one, you press the shift key and use the cursor keys (<- and ->) for the direction.
After reviewing you will seee that the proposed image "2" was not a good decision. This can be overruled by going to image "2" and pressing "r" for Reference. Furtheron you can navigate to image "4" and select this image as another "Reference", by pressing "r".
There is another set of paramters for Dflicker in the right-side of RestorationManager, but there is no need to change them for the tutorial sequence.

Press "render"   to start processing

After the job is finished you may look at the result and compare the original image with the processed one. To do this, press <CTRL><TAB>. This will open the result frame in a separate window. You can toggle between the original and processed image by pressing <TAB>. The title bar of the window shows which version is currently displayed.

OutputMovie: testsequence_R01   Sequence: TutorialSequence1   Representation: Preview

InputMovie: testsequence   Sequence: TutorialSequence1   Representation: Preview
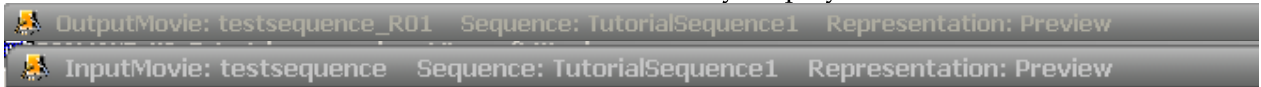
In our case go to image number "7" and verify the differences! By toggling between input and output, you can see the effects.
For full judgement you need to see it in motion by using the space-bar!

To accept the corrections, close the RestorationManager by clicking the "X" button in the top right corner of the window.

Dust
Back in the MovieManager you need to double-click on the sequence icon in the **testsequence_R01**!
The RestorationManager opens. Select the "Dust" tool from the tools list and drag-and-drop it into the work area. The work area will now show a bar which represents the dust tool.
The automatic dust removal process eliminates black and/or white spots with minimum user intervention. Big spots will be left over and removed later in a semi-automatic processing step.
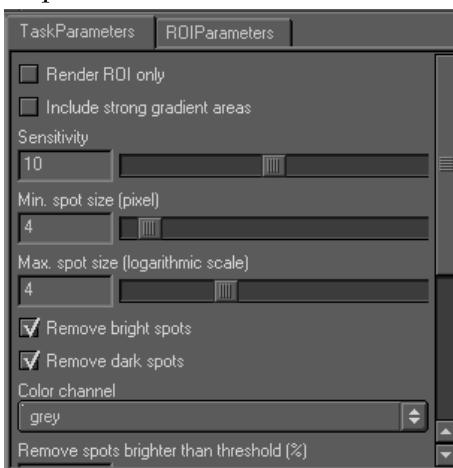
The strategy in DIAMANT to find the right settings for one module is to select one sample images, having a typical defect; choose again the image number "7".
As soon as a module is selected, the corresponding parameters appear in the parameter panel located on the top right side of the RestorationManager.

The restoration module is then applied to this single frame by pressing "render one frame":
 After reviewing the results, the parameters for the module could be adapted and the process is repeated until you are satisfied with the result on this image. By toggling between input and output, you judge the effects.

In our tutorial sequence a lot of dust has been removed but also some Grain has been taken away. The places above the hats and the chairs are too much affected.

Therefore the sliders and radio buttons should now be used to change the setting of this restoration module. Change the "Sensitivity" to "6", the "Min. spot size" to "3" and the "Max. spot size" to "3".

After verification by pressing "render one frame" you should verify the setting on another image. Take image "4" for that.

If too less spots are removed go up with the sensitivity but look carefully for not wanted side effects, if you increase the sensitivity. If small spots have not been removed, go down with the Min. spot size parameter, but be aware that it may happen that you loose wanted grain as well. If a lot of big spots have not been removed try a bigger Max. spot size, but also check for side effect. It may be better to remove big spots later on in the semiautomatic dust removement.

Now after finding the right settings for this film, render the whole sequence by pressing the

render button.
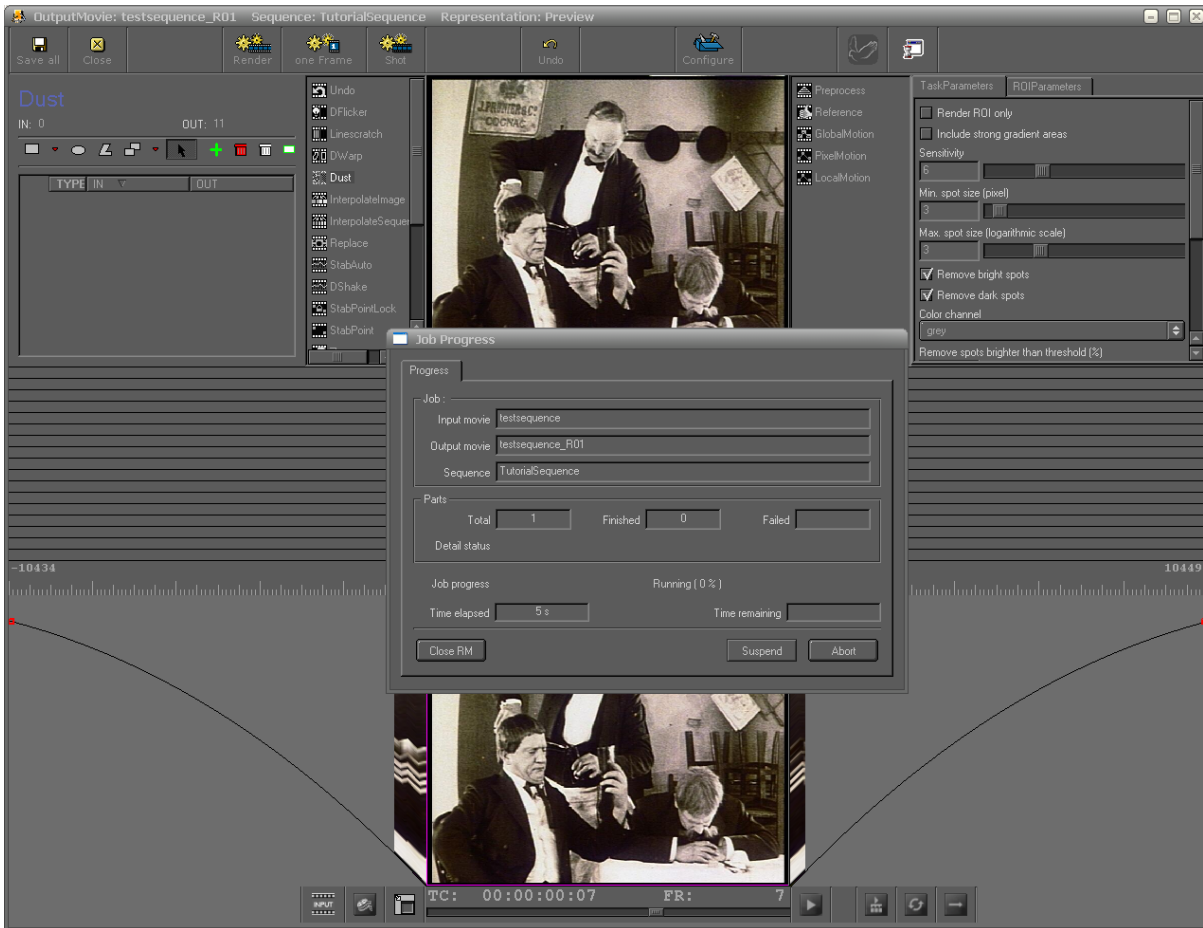
After completion you can judge the results as you did with Dflicker in the first step. When done so, close the RestorationManager by clicking the "X" button in the top right corner of the window.

Semiautomatic Restoration

Not all defects can usually be removed by the automatic pass. Therefore, DIAMANT offers a second mode of operation (we often call it "semi-automatic" mode). In this mode, the user selects the areas to be processed by the restoration modules. These areas are called "Regions of interest", or "ROIs".

Back in MovieManager, double-click the sequence icon in "testsequence_R02". The RestorationManager will open the sequence. Select again, the dust module from the modules list and pull it down into the work area.

To work with the dust module in semi-automatic mode, you use a special set of parameters.
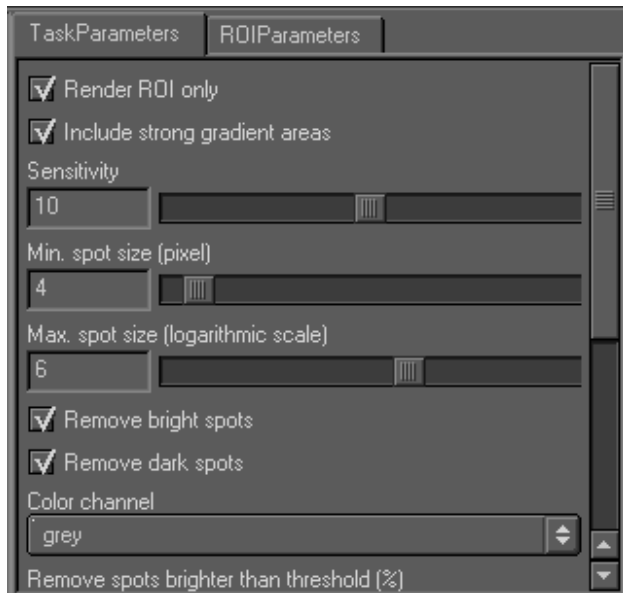
Start by drawing rectangles (1), ellipses (2), [polygons (3)] on spots which have not been removed yet. Go to image "4" and put the mouse on the upper picture. Now press 1 for rectangles or 2 for ellipses [and 3 for polygons]. Click and pull to paint these figures around

the spots. You may adjust the size also later on by pressing <Esc> and go inside or on the blue marked points within the figures and pull again.
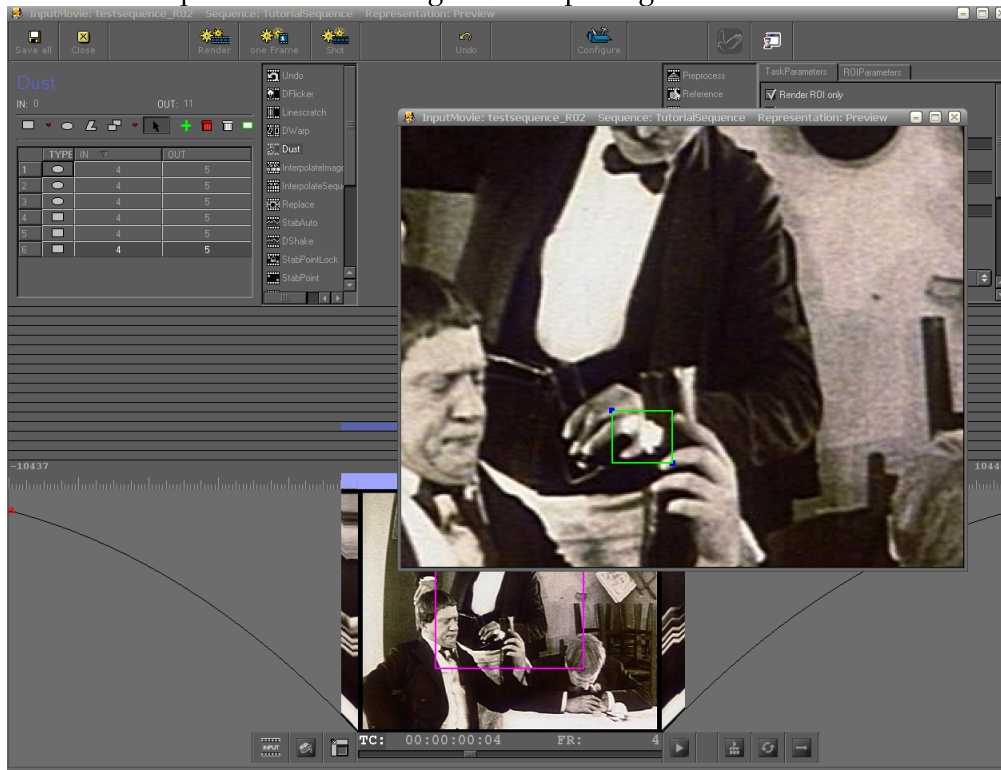
You can use this settings to mark the big white spot on the hand of the waiter in image "4". You can also mark other spots in the same image.

In our sample we have finally marked 3 spots in image "4".

There is another white spot on the hand of the waiter in image "6". **Please do not!** mark this spot as we want to keep it for the demonstration of manual restoration in the next step of the tutorial!

Depending on your restoration requirements you can go through the sequence and mark as many ROIs as you want.

After doing so, you press the "render" button again. After completion you can do a quick quality control by using Alt+"->" or Alt+"<-" for jumping from on image with marked ROI to the next.

Memorise your paramter settings:
In order to memorise your dust settings, you may also save these settings for later on. To do so, select the module and click on the right mouse button.

Go on "Save parameters" and then the following mask will occur:
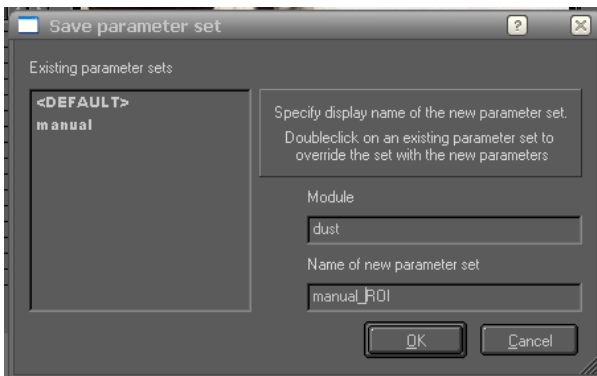
Now you can assign a name for your parameter set. Just chose one, that is convenient for your purpose (in our sample it is "manual_ROI").

You may use this setting from now on, by clicking-right on any dust-tool and selecting the "Load paramters" function.

To finish this step, close the RestorationManager by clicking the "X" button in the top right corner of the window.

8. Manual Restoration (M.I.R)

After the semi-automatic restoration, we are principally finished with the spot removal. However we want also demonstrate the the manual restoration tool, that comes along with Diamant.

For this reason we have left one hair on the first image and one white spot on the waiter´s hand in image "6".

For the restoration of such remaining defects we use M.I.R. (Moving Image Retoucher). To start, we go to the MovieManager window, select "testseunece_R03" and click on the symbol
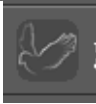
for M.I.R.

M.I.R. is opened and if the mouse is on placed on the image you will see the retouch-tool as a "monocle", showing the size of the retouch area (=small lens) and the content that would be used for fixing (=big lens). As long as you have not changed anything, you see the same part in the big and in the small lens. The brush size can be adapted with the pressed shift key and the mouse wheel.

You can start and stop playing by pressing the Space-Bar or walk step by step through the single images by using the flash keys ("->", "<-") on your keyboard. The current position is
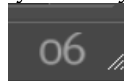

shown on the right lower corner of the main window.

On frame number "0" (on the table) and on frame number 6 (at the edge of the waiters dress) there is some dirt.

In order to repair the spots, you need to select content for repair, from another part of the sequence. In this example first go to frame number "0", focus the monocle on the spot, press <t> and slightly turn the mouse wheel. Usually you get the best results by using an immediate neighbour image in time. So just go one image further.

You can verify that, by looking on the left side beneath the small picture. The lines close around the picture are for the "x" and "y" direction you could also have chosen and the

second line is for going to other frames, which in a way means going through the "time". If you went one frame further, the value is +1.

A very conventient and usefull function is the Auto-Alignment. This function can be invoked by pressing "A" on the keyboard. As a consequence the background is automatically shifted to match the current position of the tool. You can use "A" several times after each other, to get an idea how Auto-Alignment is working.
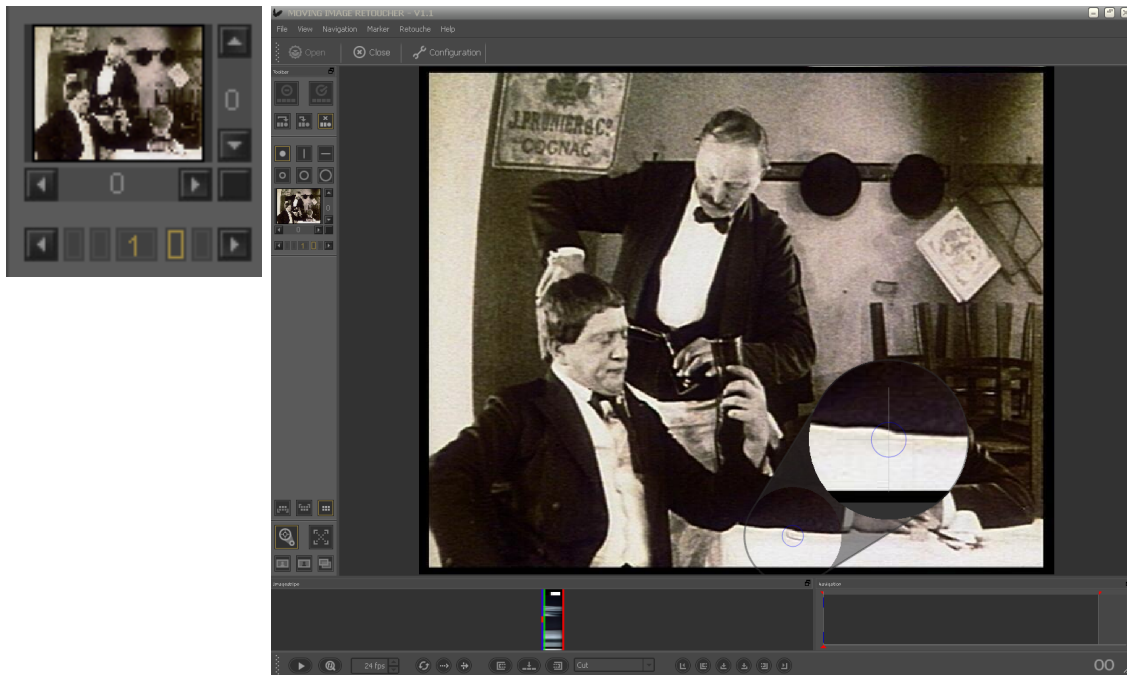

To repair the spot you just press the left mouse and move over the spot. You can try an autoalignment by pressing "A" to get an even better result.
Once you are satisvied, you fix the result by pressing "F" for fix.

Press the left mouse-button to apply the repair on the spot (and the right mouse-button to "unrepair").

You may look over the frame if there are some further defects, some further things you want to improve. If not you just go to frame number "6" and do the same procedure there.

For retouching you may adapt the brush-size by pressing <shift> and turning the mouse wheel.
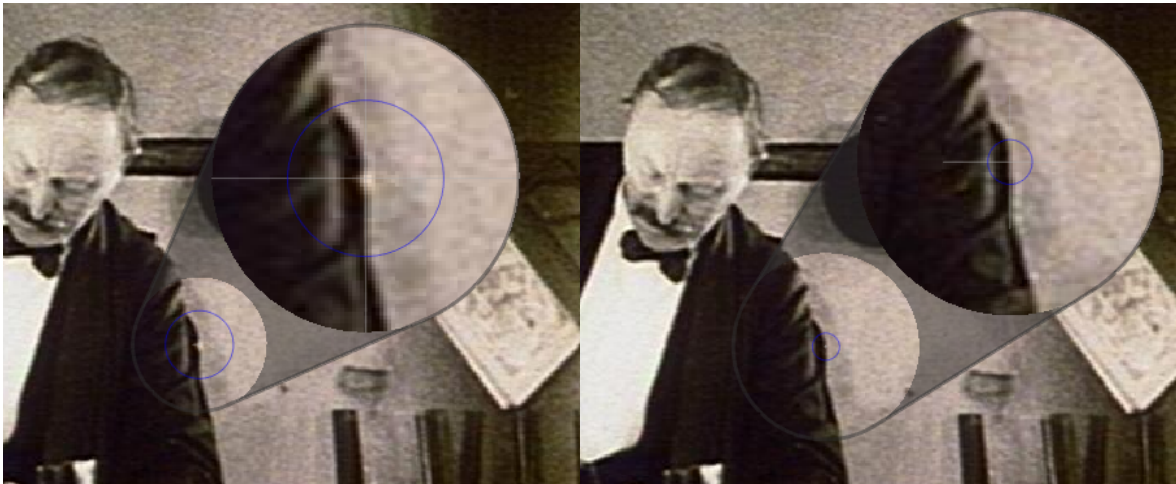
Never forget!: You always have to confirm the repair before going to the next frame. This confirmation is called "Fix". Just press "F" or use the proper symbol for application.

As long as you haven't fixed, you still can undo your repair by pressing "C" for Clear or using the right mouse-button.

To finish this step, close M.I.R. by clicking the "X" button in the top right corner of the window.

M.I.R. has a lot more possibilities. Please refer to the M.I.R. documentation for more details!

For this tutorial sequence there is nothing else left to do. For further information look inside DIAMANT V2 Manual or the separate M.I.R. Manual.

9. Further Restoration in the RestorationManager

This part will illustrate how to apply the more modules.
We will use the output of the last step (manual restoration) as the input sequence. To do this, go back to the MovieManager. In the left area of the window, you will find the reed reel "testsequence_R04".

Select the "testsequence _R04" movie in the left window area, and double-click the sequence "Tutorialsequence" in the sequences tab. This will open the RestorationManager, using the "testsequence _R04" version as the input sequence. All output images will be written to the next render generation, called "testsequence_R05". The respective input and output generations are displayed in the title bar of the RestorationManager window.

First we want to do a DNoise in order to make the sequence more fluent. As the default parameters are quite good, we propose to take the DNoise (drag-and-drop) and leave the parameters unchanged!

In order to avoid loss of conrast on border we use a Sharpen after it. We propose to use the tool very softly and thus invite you to change the "Strongness" to a value of "1".

Finally we add a Dshake to stabilise the sequence. Here you can leave the default settings.
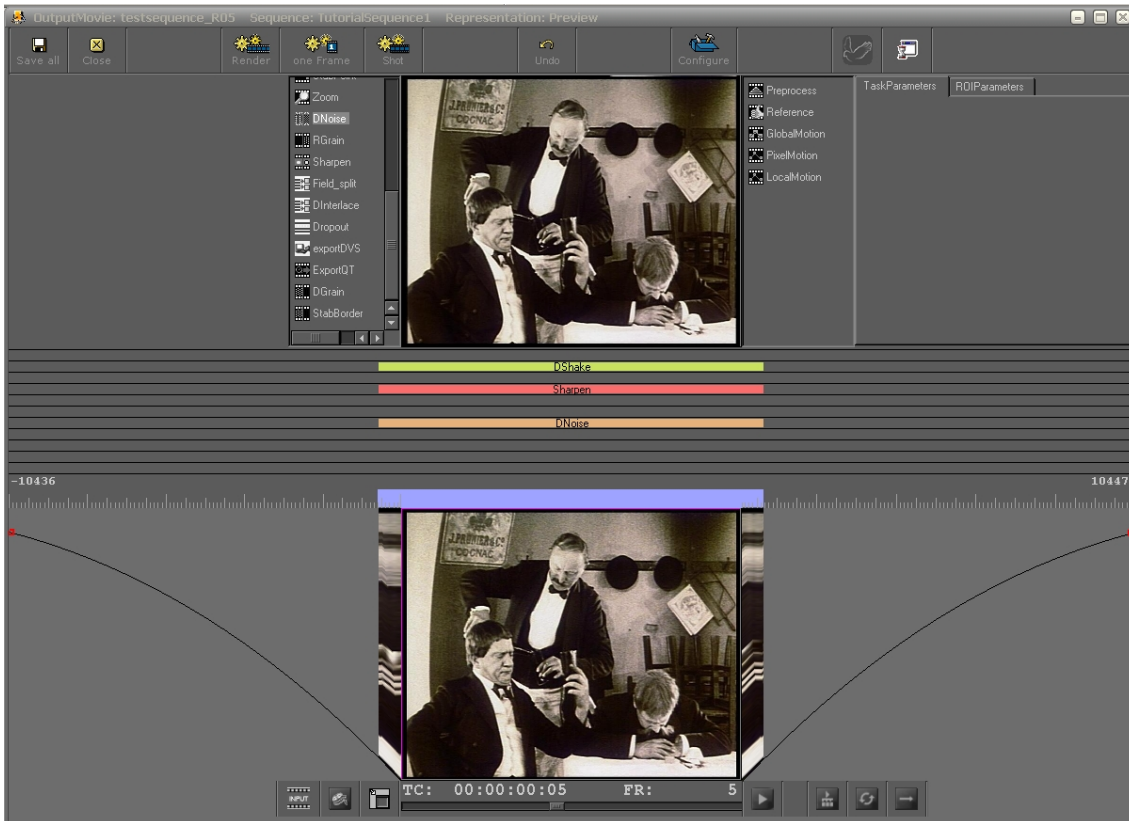
Render the whole sequence by clicking the "render" button. The results will be written to the next render generation, called "testsequence _R05".

To finish this step, close the RestorationManager by clicking the "X" button in the top right corner of the window.
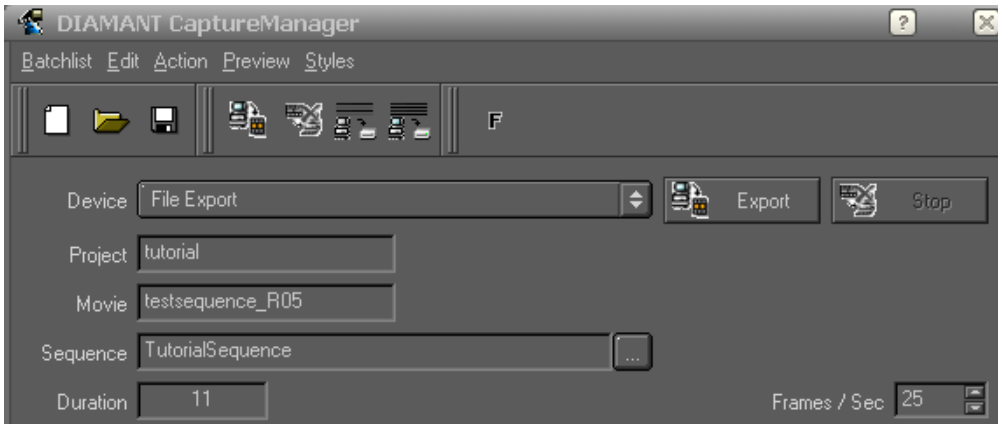
10.   Export

At the end of the restoration process, the result has to be exported out of the DIAMANT system. This is done by the CaptureManager.
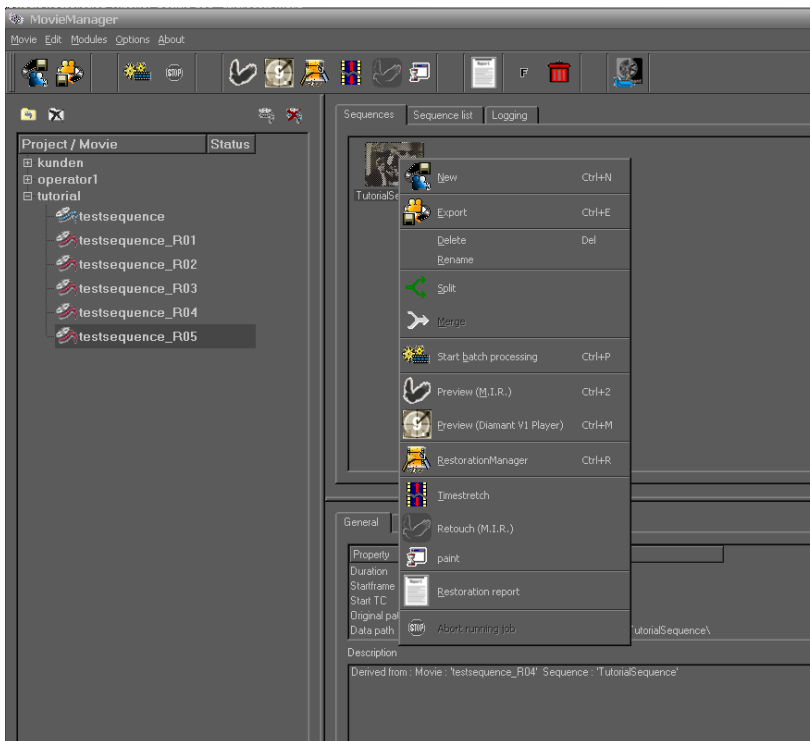
The Export process starts from the MovieManager. In the left pane, select the last render generation of your movie; in our case, this should be "testsequence _R05". Now, right-click the image sequence in the "Sequences" pane to open the context menu. From the context menu, select the "export" command.

This will open the CaptureManager, with the project-, movie- and sequence-names already in place. Note that the device selection box shows "Device: File Export".

Next, click the "Target" tab in the middle of the window to access the target settings. Here,

you can enter which directory the sequence will be exported to. Use the [...] button to browse for the desired output directory.

In the file mask panel, the output file mask can be entered. This works in the same way as with the file import. The desired output file format is also selected here.

For the tutorial, we assume that we want to export the files to a directory called "c:/Diamant/Output". The files shall be called "TutorialFinal_" with a 6 digit number and shall be in JPG format. With all this information entered, the Target tab looks like the following:
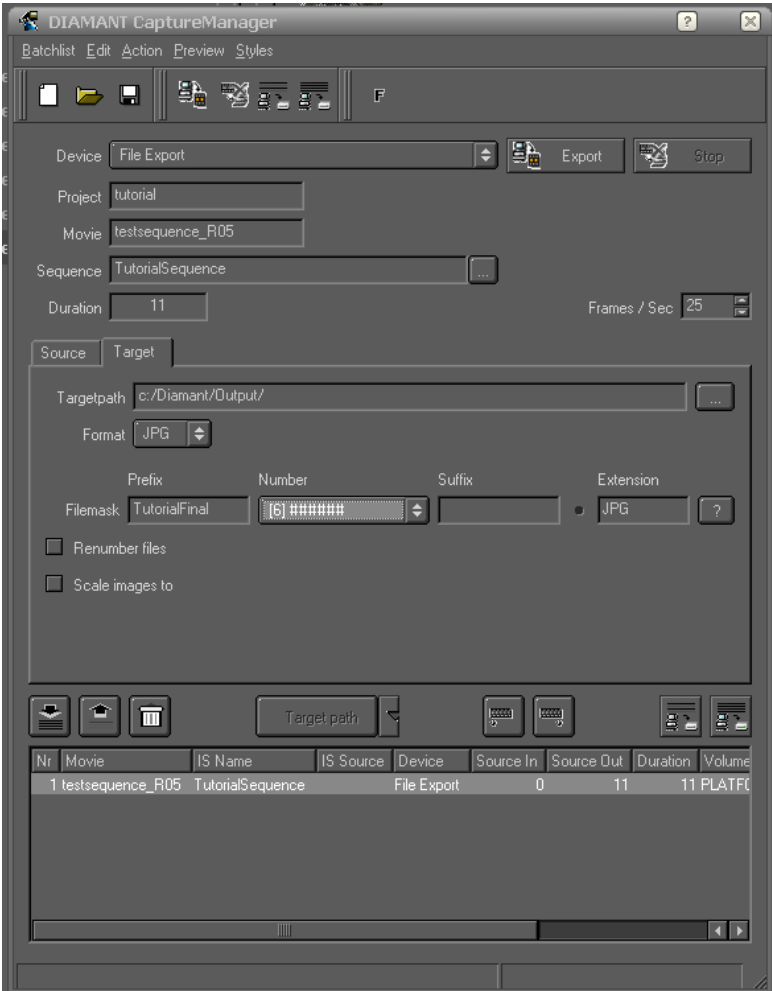
After entering all this necessary data, the export process can be started by clicking the "Export" button at the top right side of the window.

After clicking this button, the DIAMANT system will write the result images into the selected directory.

11.   Practical Tips

Some Suggestions for Module Order

This part is a basic working guideline. It gives an advice in which case which workflow of the modules should be used.

First of all one has to check the film by playing the sequence and make a classification occurring the following circumstances.

- Camera movement,
- Object movement,
- Stabilization problems,
- Dust,
- Brightness problems,
- Grain.

Second, one has to decide which kind of modules are wanted and which kind of workflow would be best (e.g.: one has to decide if stabilisation is beter to be done before any other step and if grain-reduction is desired,….).

Third, one has to find the right settings; therefore one has to do an analysis mainly on a few typical frames. These frames should not be the worst but also not the easiest ones. One should verify the settings on a few single images and check the effects and side effects. If one has found a setting with good results and few side effects, it can be used for all other frames.

Some overall ideas to the modules and the workflow

- If there are serious flicker problems, run DFlicker first. Good values are achievable by using:
    - Flicker Locality: Local motion and moving object compensation
    - Flicker Locality: Global motion without moving object compensation

- If the stabilization problems are very high as well, run one of the stabilization modules just after DFlicker. Try DShake or StabAuto in the first place! Be aware that stabilisation results in invalid motion data, thus localmotion, pixelmotion and global motion have to be re-caculcated for further restoration steps.
- If the stability problemis moderate, it is generally more efficient to do stabilization as last step. Do dust, linescratch and interpolation before!
- Run dust in a two-step approach; first a fully automatic mode with moderate aggressivity and then a second semi-automatic mode with manual marked ROIs.
- Using a high reliablity rate with DNoise minimises side effects on moving objects.
- To avoid too much softening through the DNoise module, use Sharpen in conjunction.
- DNoise can also be used to reduce color stain effects and unwanted color or brightness effects caused by undo or interpolation.
- Use interpolation mainly with local motion (or global motion, if there is less object movement and only one camera pan), avoid freeze front or back frame!

Resolution depending remarks

To use DIAMANT best one has to take the resolution of the material into consideration. If you do the batch processing click on the points next to PixelMotion, LocalMotion and GlobalMotion you will get the settings fitting to the resolution.
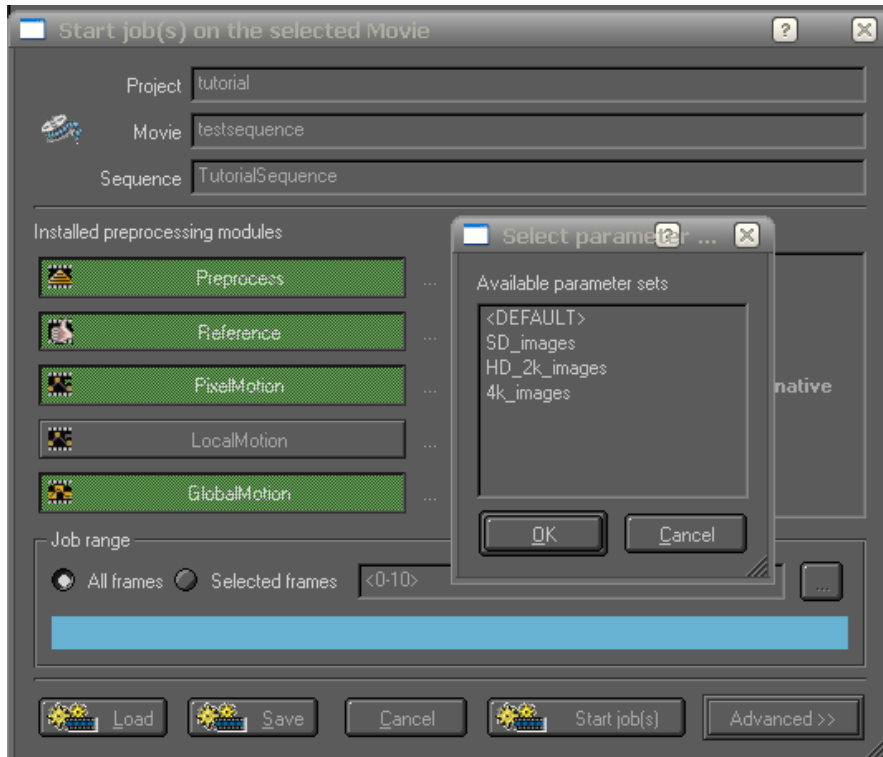
4k Images
- PixelMotion: low
- Local motion setting: low
- Global motion setting: low
- Dust: Min. Spot Size: Starting Point 20
- DNoise: never take more than 1 pixel for Noise/Grain size
- DNoise: Precision: low

HD, 2k Images
- PixelMotion: standard
- Local motion setting: standard
- Global motion setting: standard

<u>*SD Images*</u>
- PixelMotion: high
- Local motion setting: high
- Global motion setting: high
- Use DShake

12. Closing Words

This tutorial can only give a short introduction on how to work with DIAMANT. Deeper knowledge on the software and workflow can be gained by restoring several trial sequences, simultaneously consulting the DIAMANT V2 Manual for further detailed information.

In case of any ambiguities, you are invited to contact HS-ART Digital user support for specific information and troubleshooting.

> HS-ART Digital Service GmbH
>
> support@hs-art.com
>
> tel: +43 316 915998 0
>
> (you can use English, German and French language!).

There is no unique and overall best way to operate DIAMANT. Depending on the original material, input data format, desired restoration quality, available project resources and internal company workflow, each costumer has to find the optimum way of applying the DIAMANT software as a stand-alone tool or in conjunction with other restoration tools on site.